

# Factors Affecting A Municipality's Bond Rating: An Empirical Study

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## ABSTRACT

*Creditworthiness, as reflected in bond ratings, is of great interest to municipalities since it directly affects the cost and ability to borrow money. Municipalities experiencing a decline in their economic health will be especially concerned about how these developments will impact their future bond ratings. It is well known that municipal analysts closely monitor a community's economic health since this has an important impact on creditworthiness. What is less well known however, are the economic variables that influence bond ratings. The purpose of this paper is to identify these economic variables and estimate to what extent they influence the probability of a municipality's default. We do so by developing an econometric model of the rating process. The model will allow municipal governments to gauge the impact of economic developments on their credit ratings.*

## BOND RATING METHODOLOGY

 ne of the major bond rating agencies is Moody's Investor Services. The basics of their bond rating methodology have been clearly presented in several papers (Moody's Investors Service 2002a, 2002b, 2002c, 2003 and 2004), and in one comprehensive text<sup>1</sup> (Smith, 1979). These sources identify a number of factors that determine the underlying creditworthiness of governments that issue long-term municipal debt. These factors can be summarized under the following general headings:

- Economic and demographic characteristics of the local area.
- Fiscal condition of the municipality.
- Constraints imposed by or dependence on other governmental units.
- Debt levels and other financial factors.

In the local economy, variables such as population, income, employment, unemployment, industrial mix, and earnings of employees may well draw the attention of credit analysts. Concentrations of employment in one industrial sector or with one employer may make a community more susceptible to instability than it would be with a more diversified economic base. Of course this begs the question of whether it is better to have one high paying employer in the community or a well diversified group of substantially lower paying institutions. Over the 30 year period since Wade Smith's book concerning the appraisal of municipal creditworthiness was first published, the American economy has lost over six million manufacturing jobs and established many more opportunities in the service economy<sup>2</sup>. Although ideas about what drives a local economy have changed over this period, the importance of wage generation in the determination of high credit quality has not.

The fiscal health of the municipality is related directly to the revenue it receives and the money it expends to provide services. The fiscal capacity of a community is determined by the size of the bases which can be taxed. Local governments in the U.S. rely most heavily on property values, the level of sales, and wages or income as their principal tax bases<sup>3</sup>. Both directly and indirectly, the level of earnings in a community affects the size of these bases and the tax revenues they can generate.

Fees and charges are a second source of revenue for most local governments. They can be collected for the provision of such services as water and sewerage treatment, housing, health care, utilities, and transportation facilities. As with tax collections, some of this revenue source can be exported to consumers outside of the jurisdiction collecting the fees, but some part of the revenue generation depends upon the level of earnings and income within the local government area.

The third element of a community's fiscal capacity is the intergovernmental transfers that it receives. These transfers can be categorical or general, formula or project, matching or lump-sum. Their purpose can be to share revenue or to stimulate governmental activity. Whatever the reason for the grants, the recipient community's ability to provide public services are affected and may result in diminished local contributions to pay for those services.

State governments that mandate expenditure programs that the local governments must pay, often pick-up part of the financing responsibility for these services<sup>4</sup>. When recipient governments become overly dependent on intergovernmental revenue, they can have their creditworthiness compromised in two ways. The first is by the credit rating of the donor government sending the aid. It is difficult for a recipient government to be perceived as sounder than the government which provides 35 to 40 percent of the recipient government's revenues. Secondly, if the aid flows are ad hoc in nature and are appropriated on an emergency basis, then they could be perceived as more easily interrupted than aid that is built into a formula and is viewed as ongoing. In addition, states can affect a local government's revenue raising capacity through tax and debt limits.

Finally, the existing levels of debt will impact the conditions and costs of borrowing new money. It is not just the debt of the issuing government that is a factor in the perception of the likelihood of default. Many local governments are part of a system of local jurisdictions. It is possible for a tax base to be responsible for making debt service payments for a village, town, county, and school district, as well as a variety of special assessment districts. The debt of all overlying governments needs to be identified to give an accurate picture of these inter-relationships. Other financial considerations include the adequacy of budgeting for future pension expenses and capital replacement.

The aforementioned determinants of creditworthiness are not independent of one another. A community that has undergone significant economic restructuring that has led to reduced employment and a significant reduction in earnings per worker could also experience declines in housing market values. These declines, in turn, will erode assessed valuations and the tax base, leading to lower tax collections, higher tax rates, or both. In a similar fashion, declining earnings per worker and lower incomes can lead to reductions in consumer spending with an accompanying drop in sales tax collections. On the expenditure side, an increase in unemployment combined with the out-migration of the most productive workers in a region, can lead to an increased dependency of the population within the region on governmental support. This double squeeze leads to increased fiscal stress on the local government with the responsibility to finance income maintenance and other social service programs.

This discussion clearly illustrates that the bond rating process is a complex one. Capeci (1991) provides an excellent discussion of the difficulties of developing a bond rating model. He points out that rating agencies and bond investors have an enormous amount of information at their disposal. It is highly unlikely that a model could capture all of this information. Even if it could, there would not be enough degrees of freedom left to allow statistical testing. Moreover, there are relevant considerations that are difficult to quantify such as the willingness of a state to intervene on behalf of a bankrupt municipality that may affect the perceived riskiness of the municipality's bonds<sup>5</sup>.

Given these difficulties, we have followed Capeci's approach of identifying a subset of variables that we hypothesize will be related to bond ratings. Our intent is to identify key elements that are important in the rating process. Using variable definitions employed by Moody's, and relating them to the general characteristics discussed earlier, we have selected the following variables to represent the economic and demographic characteristics of the issuing government: earnings per worker in the metropolitan area, assessed value per capita, and the regional unemployment rate. The fiscal condition and intergovernmental factors are proxied by the ratio of tax revenues to expenditures. Excessive dependence on interruptible intergovernmental aid or low local tax efforts would be reflected in a low ratio of tax revenues to expenditures. While overlying debt levels were not available, total general obligation debt per capita in the municipality represents future claims on the revenue raising capacity of the issuing government.

## THE BOND RATING MODEL

The Moody's rating agency currently places a governmental bond issue into one of the following categories arranged from highest credit quality and lowest probability of default to lowest credit quality and highest probability of default: Aaa, Aa, A, or Baa, with gradations within each class of 1, 2 or 3. The existence of third party enhancements in the form of insurance or a state government guarantee, has significantly complicated the process of identifying the underlying credit rating of issuing governments<sup>6</sup>. The data used to test this model is from the 1980's and early 1990's, when third party enhancements were far less common. Only issues without credit enhancements were evaluated. The credit ratings used during this period only subdivide each category into two components, such as Aa1 or Aa, thus yielding seven rating categories of investment grade bonds, Aaa to Baa.

There exists an underlying latent index for each bond issue,  $Y_i^*$ , that determines the probability of default and consequently, the bond's rating.  $Y_i^*$  is related to a set of economic, fiscal and financial explanatory variables ( $X_i$ ) via the following relationship:

$$Y_i^* = \sum_{i=1}^K \beta_i X_i + \varepsilon_i \quad (1)$$

where  $\varepsilon$  is a random error term with mean zero. Although  $Y^*$  is unobservable, we know the rating ( $Y_i$ ) assigned to bond  $i$ .  $Y_i$  can take on the following values:

$$\begin{array}{lll} Y = 1 & \text{if } Y^* \leq \mu_1 & (\text{bond is rated Aaa}) \\ = 2 & \text{if } \mu_1 < Y^* \leq \mu_2 & (\text{bond is rated Aa1}) \\ = 3 & \text{if } \mu_2 < Y^* \leq \mu_3 & (\text{bond is rated Aa}) \\ = 4 & \text{if } \mu_3 < Y^* \leq \mu_4 & (\text{bond is rated A1}) \\ = 5 & \text{if } \mu_4 < Y^* \leq \mu_5 & (\text{bond is rated A}) \\ = 6 & \text{if } \mu_5 < Y^* \leq \mu_6 & (\text{bond is rated Baa1}) \\ = 7 & \text{if } Y^* > \mu_6 & (\text{bond is rated Baa}) \end{array} \quad (2)$$

The  $\mu_i$ 's represent cutoff points for the ratings associated with a particular bond issue. As the value of  $\mu_i$  increases, the rating agency attaches a lower rating to the bond issue.

The polychotomous dependent variable defined in (2) is ordered but does not form an interval scale. For example, consider bond 1 that is rated Aaa and therefore,  $Y=1$ . Suppose that the credit analyst rates bond 2 as Aa1 and  $Y=2$ . Bond 2 does not necessarily carry twice the risk as bond 1. Consequently, the coding of the dependent variable is a matter of convenience.

Substituting the observed rating on bond  $i$  into equation (1) and specifying the economic, fiscal and financial explanatory variables that we hypothesize are related to the rating yields the following model:

$$Y_i = \beta_0 + \beta_1 \text{Earn}_i + \beta_2 \text{Assessed}_i + \beta_3 \text{Debt}_i + \beta_4 \text{TaxExp}_i + \beta_5 \text{UR}_i + \varepsilon_i \quad (3)$$

where:

$\text{Earn}_i$  = earnings per worker in the overlying county of the municipality issuing bond  $i$

$\text{Assessed}_i$  = assessed value per capita in the municipality issuing bond  $i$

$\text{Debt}_i$  = level of outstanding general obligation debt in the municipality issuing bond  $i$

$\text{TaxExp}_i$  = ratio of tax revenues to expenditures in the municipality issuing bond  $i$

$\text{UR}_i$  = unemployment rate in the metropolitan area encompassing the municipality issuing bond  $i$

Since smaller values of the dependent variable imply higher creditworthiness and a lower probability of default, a negative value of an estimated coefficient indicates a direct relationship between credit quality and that

explanatory variable. We expect the coefficients on both the earnings per worker and assessed value variables to be negative. *Ceteris paribus*, regions with higher earnings per worker are economically healthier, should be more creditworthy, and have a lower probability of defaulting. Similarly, regions with higher assessed property values per capita have a wider tax base and a lower probability of default. Higher unemployment rates may indicate weakness in the economic base and lower credit quality.

The coefficient on general obligation debt is expected to be positive, since higher levels of outstanding debt imply greater commitments to other creditors, an increased debt burden, and an increased probability of default. Along the same line, the ratio of tax revenues to direct general expenditures should generate a coefficient that is negative since a higher ratio implies greater capacity to meet local needs as well as a lower dependence on intergovernmental aid, which could be unavailable at the same levels in the future.

## THE DATA SET

A combination of Census Bureau governmental information combined with Comprehensive Annual Financial Reports (CAFRs) and information publicly available from BLS, BEA and the Bond Market Association were used to construct the variables in (3). Given the problem associated with credit enhancements such as insurance, letters of credit, or state guarantors, more than 400 long-term bond issues from the mid-1980's and early 1990's without enhancements were assembled and analyzed. After constructing the explanatory variables and omitting observations with missing information, only 159 bond issues remained in the data set. To align the information available to the municipal analyst as closely as possible with the date of issue, the demographic information is from the beginning of the period, 1986, while the fiscal information and financial data is for the date of issue.

## EMPIRICAL RESULTS

As a first step, the parameters in equation (3) were estimated using Ordinary Least Squares. The estimates are reported in Table 1. All of the coefficients, except for general obligation debt, have the expected sign and are significantly different from zero. The coefficients on earnings per worker, assessed value per capita and the unemployment rate, are significant at better than the 1 percent level. The p-value on the tax revenue to expenditure ratio is .0356. The coefficient on the general obligation debt variable does not have the expected sign but is not significantly different from zero.

It is well known that estimation of models with limited dependent variables via ordinary least squares may result in predicted probabilities that lie outside the zero to one range [see Maddala (1983), Liao (1994)]. Furthermore, to account for nonlinearities in the population regression function, equation (3) was also estimated assuming that the error term follows a normal distribution, as well as a logistic distribution.

**Table 1**  
**OLS Estimates of Equation (3)**

Variable	Coefficient	t-statistic	P-value
Constant	5.6616	9.984	.0000
Earn	-0.0000926	3.560	.0005
Assessed	-0.0004310	2.767	.0064
Debt	-0.0004660	.339	.7354
TaxExp	-0.829018	2.120	.0356
UR	0.122386	4.634	.0000
R <sup>2</sup>	.310		
SER	1.087		
F-statistic	13.776		

The estimated probit and logit coefficients appear in Table 2. The results are very similar to those in Table 1 in terms of the signs and significance of the estimated coefficients. The general obligation debt variable now has the expected sign, but it is still not significantly different from zero. The likelihood ratio test statistics for both the logit and probit estimates indicate that we can reject the null hypothesis that all the parameters on the explanatory variables are jointly zero, far in excess of the 1 percent significance level.

**Table 2**  
**Logit And Probit Estimates Of Equation (3)**

Variable	Logit Coefficient	Z-statistic	P-value	Probit Coefficient	Z-statistic	P-value
Earn	-.000162	-3.484	.0005	-.0000913	-3.491	.0005
Assessed	-.000740	-3.021	.0025	-.000408	-2.724	.0064
Debt	.00000049	.374	.7087	.00000039	.607	.5439
TaxExp	-1.70389	-2.493	.0127	-.844002	-2.212	.0269
UR	.207638	4.258	.0000	.119069	4.406	.0000
<b>Limit Points</b>						
$\mu_1$	-6.3731	-5.757	.0000	-3.5095	-5.719	.0000
$\mu_2$	-5.5541	-5.246	.0000	-3.0947	-5.170	.0000
$\mu_3$	-4.2539	-4.199	.0000	-2.3798	-4.095	.0000
$\mu_4$	-2.1903	-2.266	.0235	-1.1678	-2.066	.0389
$\mu_5$	-0.0335	-0.035	.9723	0.0716	0.127	.8990
$\mu_6$	0.9591	0.950	.3419	0.5912	1.025	.0355
Log Likelihood	-222.75			-222.76		
Likelihood ratio test statistic	56.72			56.71		
McFadden $R^2$	.113			.113		

The only variable that did not perform as expected in the model is general obligation debt. At first we believed that the performance of this variable was due to its specification as an absolute number that might be measuring size. Accordingly we tried the following alternative specifications of the variable:

- Debt as a percent of assessed value
- Debt as a percent of personal income
- Debt as a percent of total revenue

None of these specifications produced the expected results. We hypothesize that the lack of significance of the general obligation debt variable may be obscured by the presence of insured debt. While it was possible for us to exclude insured debt from the issues that were used to test the model, it was not possible to exclude other insured debt of the municipality that would be included in the general obligation debt variable.

In addition to the estimated values of the  $\beta$  coefficients, we also provide estimates of the cutoff points ( $\mu_i$ 's) for the latent variable  $Y^*$  that place a bond issue into a specific rating category. The estimated values of  $\mu$  specified in (2) along with their z-statistics are shown for both the Logit and Probit models in Table 3.

## CONCLUSIONS

The fundamental restructuring of local economies in many areas of the country has led to fewer workers in the relatively higher paying goods producing sectors. These higher paying jobs have been replaced by lower paying service sector jobs. This restructuring can lead to lower tax revenues and increased costs resulting from increased demand for social service programs, which will place greater stress on the fiscal positions of municipal governments and affect their creditworthiness.

The resulting budgetary stress has made headlines around the country. The credit rating agencies are aware of the linkage between earnings per worker and credit quality. Thus, one should not be surprised if credit ratings deteriorate, and local governments are forced to turn to more expensive enhanced borrowing instruments such as insured bonds. The purpose of this paper has been to identify a set of variables that are related to bond ratings and to measure their impact on the probability of default. Five variables that reflect a municipality's economic strength, fiscal health, level of existing debt, and the effects of other related governmental units were identified and tested on a sample of uninsured bond issues. The tests were run using the Ordinary Least Squares, Logit and Probit estimation techniques. The results were much as expected. For the most part, the coefficients on the explanatory variables had the anticipated signs and were statistically significant. Only the variable measuring the level of general obligation debt failed to perform as expected. The results of this analysis show some important factors that are related to a municipality's credit worthiness and bond rating. They identify variables that should be monitored when a community is concerned that its credit rating may be downgraded.

## ENDNOTES

<sup>1</sup> These papers can all be viewed at [www.moodys.com](http://www.moodys.com) in the ratings methodology section. Wade Smith's seminal work has been available to the public since 1975.

<sup>2</sup> See Bureau of Economic Analysis *Employment and Earnings* at [www.BEA.gov](http://www.BEA.gov)

<sup>3</sup> See 2002 Census of Governments *Compendium of Governmental Finances* for detailed information at [www.census.gov/gov](http://www.census.gov/gov)

<sup>4</sup> A comprehensive overview of these relationships can found in *Federal-State-Local Fiscal Relations*.

<sup>5</sup> See Capeci (1991), p. 43

<sup>6</sup> As shown in *A Decade of Municipal Bond Finance, The Bond Buyer*, April 7, 2005, 56 percent of all debt in 2004 had some form of credit enhancement.

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